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Bacchetti

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(54) **CONCEALABLE HINGE FOR THE CONTROLLED ROTATABLE MOVEMENT OF A DOOR, IN PARTICULAR A REINFORCED DOOR**

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(65) **Prior Publication Data**

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Related U.S. Application Data

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(51) **Int. Cl.**
E05D 11/00 (2006.01)
E05D 5/06 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC ***E05D 11/0054*** (2013.01); ***E05D 5/06*** (2013.01); ***E05D 5/121*** (2013.01); ***E05D 7/04*** (2013.01);
(Continued)

(58) **Field of Classification Search**
CPC E05D 11/0054; E05D 7/06; E05D 11/00; E05D 5/06; E05D 11/06; E05D 5/121; E05D 7/0423; E05D 7/04; E05D 11/105; E05D 2007/0492; E05F 5/02; E05F 5/08; Y10T 16/53225; Y10T 16/5323; Y10T 16/53235; Y10T 16/53238; Y10T 16/53253; Y10T 16/533; Y10T 16/54021; Y10T 16/625; Y10T 16/628; Y10T 16/6285; Y10T 16/558; Y10T 16/5525; Y10T 16/554; Y10T 16/54028; E05Y 2800/678; E05Y 2600/502; E05Y 2600/41; E05Y 2201/628; E05Y 2201/638
USPC ..... 16/250, 322, 85, 86 R, 86 A, 238–241, 16/245, 387, 379, 382, 334; 49/398
See application file for complete search history.

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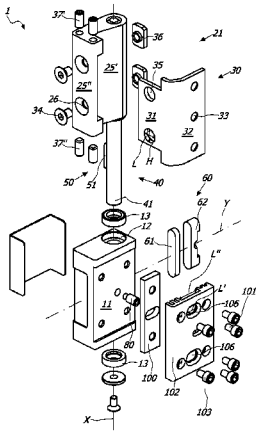
(57) **ABSTRACT**

An Anuba concealed hinge for rotatable moving a door, in particular a reinforced door, connected to a tubular support structure, which includes a rear counterframe anchored to a wall and a front frame anchored to the counterframe The hinge includes a lower fixed half-hinge and an upper movable half-hinge rotatably coupled to each other for rotating about a first longitudinal axis between an open position and a closed position. The lower fixed half-hinge includes a box-shaped hinge body to be concealedly inserted within the tubular support structure. The upper movable half-hinge includes a connecting plate connected to the door to extend from the tubular support structure in the open position and to concealedly retract within the tubular support structure in the closed position. The movable half-hinge includes a pivot defining the first axis unitarily connected to the connecting plate. The hinge body (**11**) includes a seat internally housing the pivot.

18 Claims, 12 Drawing Sheets



(51) **Int. Cl.**

E05D 5/12	(2006.01)
E05D 7/04	(2006.01)
E05D 11/06	(2006.01)
E05D 11/10	(2006.01)
E05D 7/06	(2006.01)
E05F 5/02	(2006.01)
E05F 5/08	(2006.01)

(52) **U.S. Cl.**

CPC ***E05D 7/0423*** (2013.01); ***E05D 7/06*** (2013.01); ***E05D 11/00*** (2013.01); ***E05D 11/06*** (2013.01); ***E05D 11/105*** (2013.01); ***E05F 5/02*** (2013.01); ***E05F 5/08*** (2013.01); *E05D 2007/0492* (2013.01); *E05Y 2201/628* (2013.01); *E05Y 2201/638* (2013.01); *E05Y 2600/41* (2013.01); *E05Y 2600/502* (2013.01); *E05Y 2800/678* (2013.01); *Y10T 16/54028* (2015.01)

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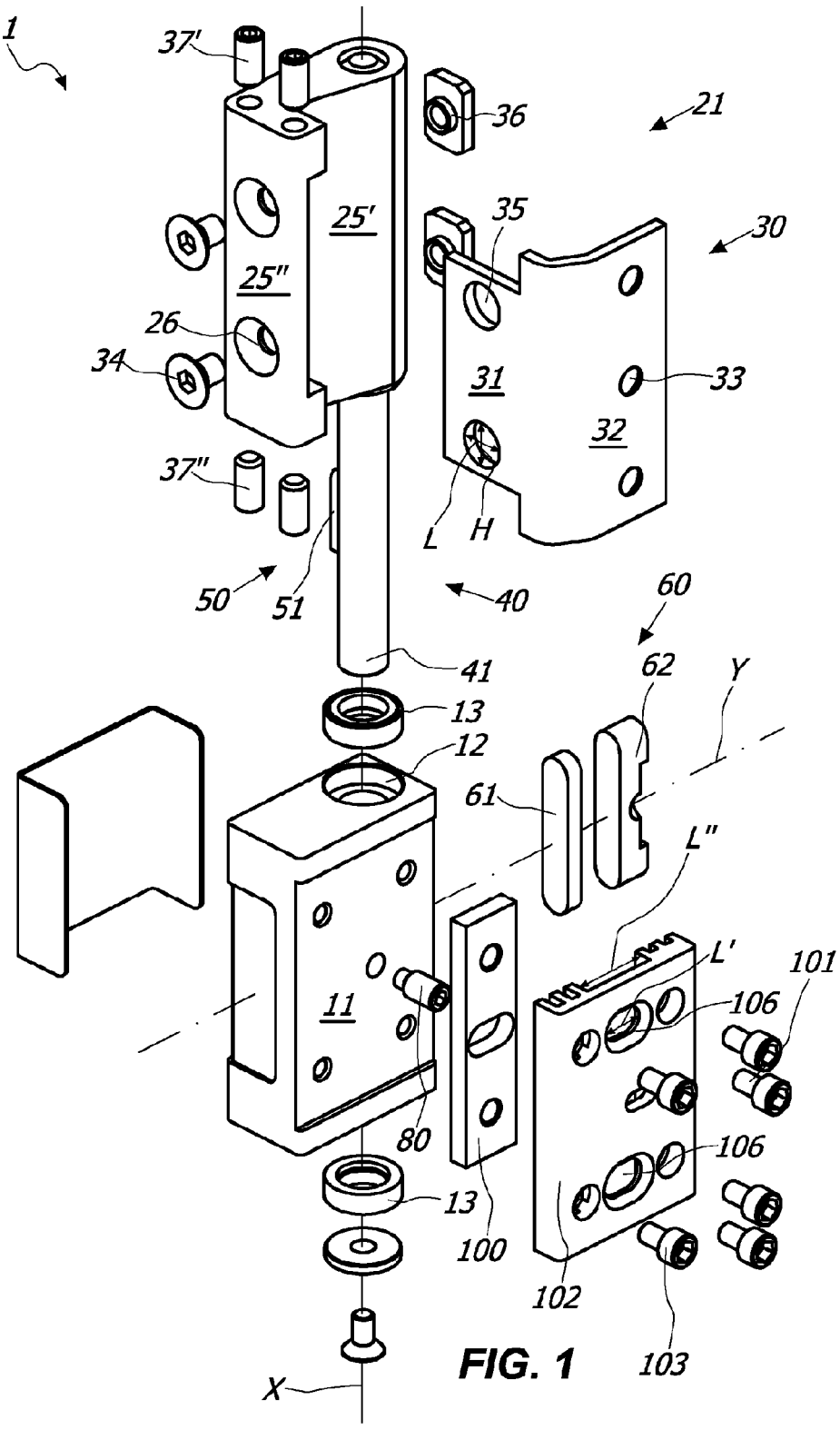
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FIG. 1

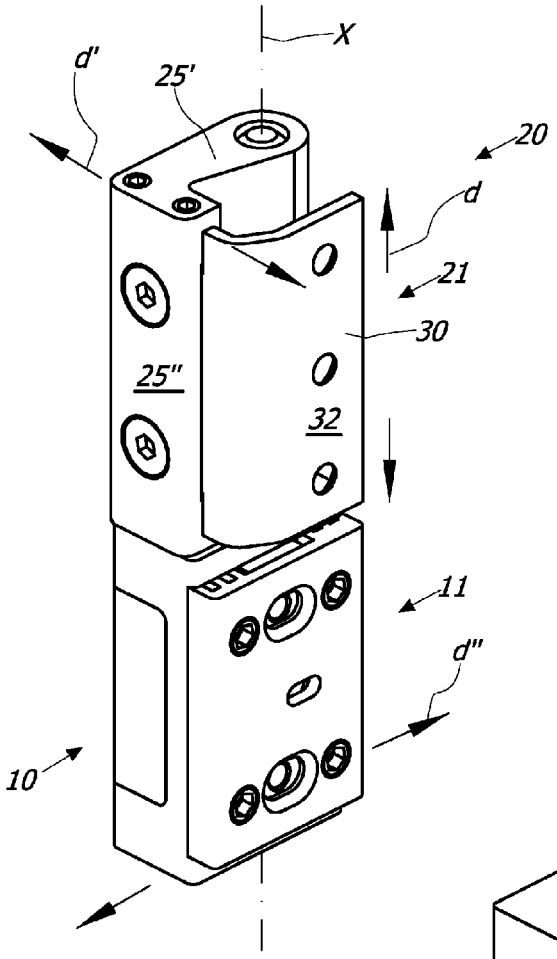


FIG. 2a

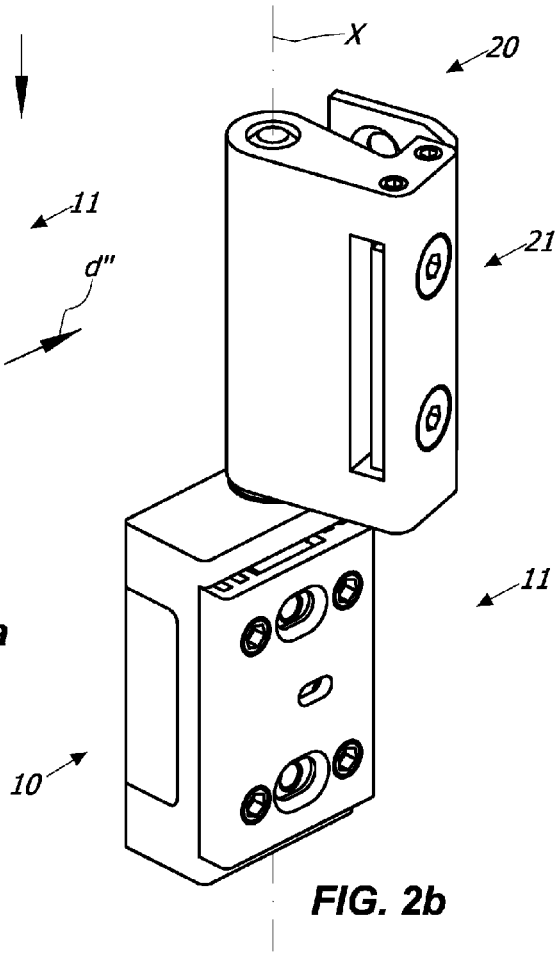


FIG. 2b

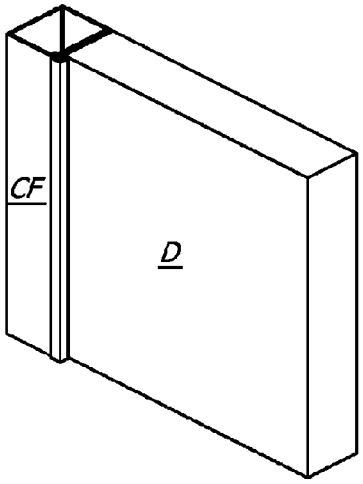


FIG. 3a

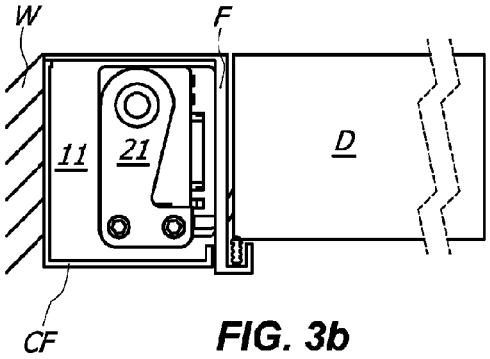


FIG. 3b

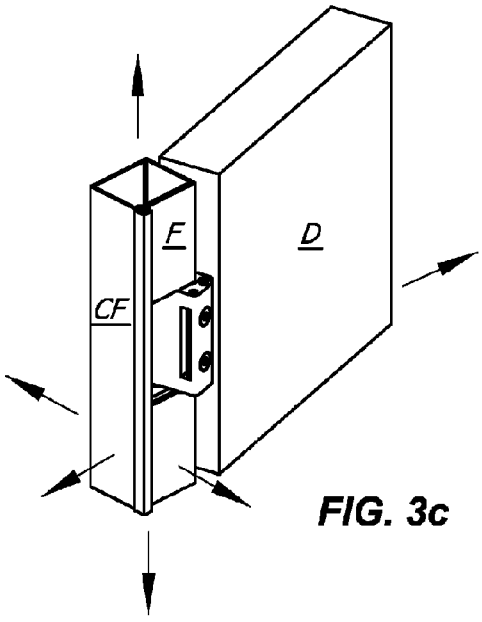
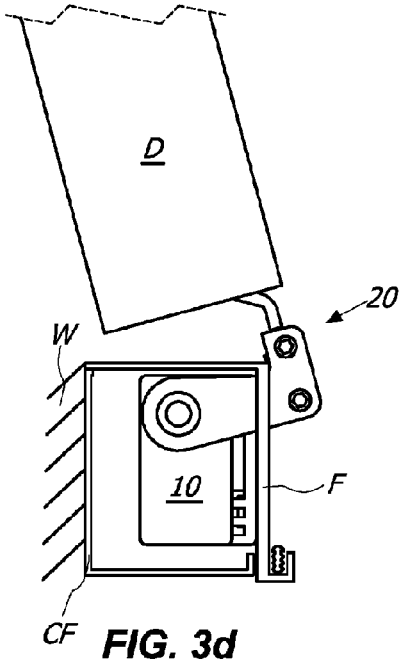


FIG. 3c



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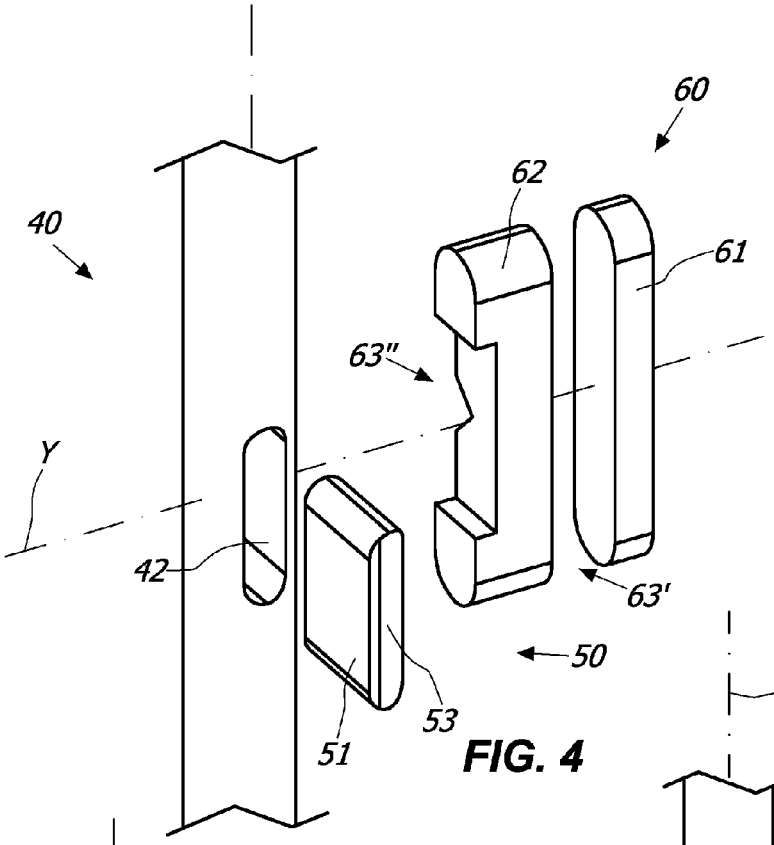

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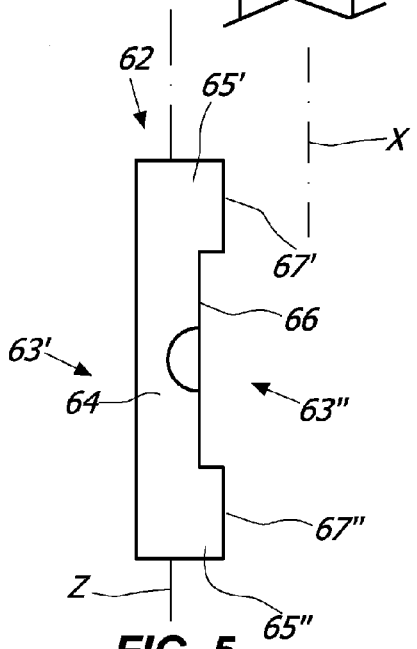
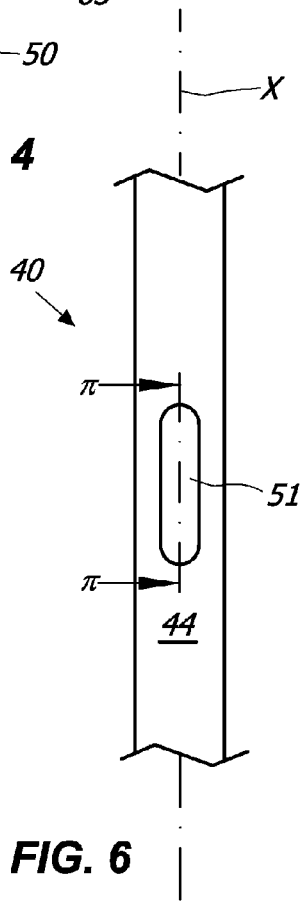


FIG. 5



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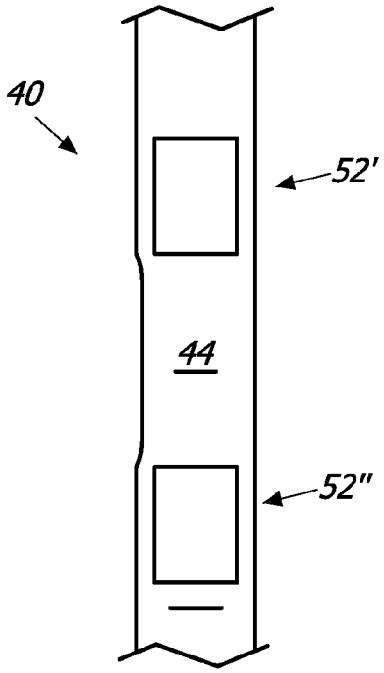


FIG. 7a

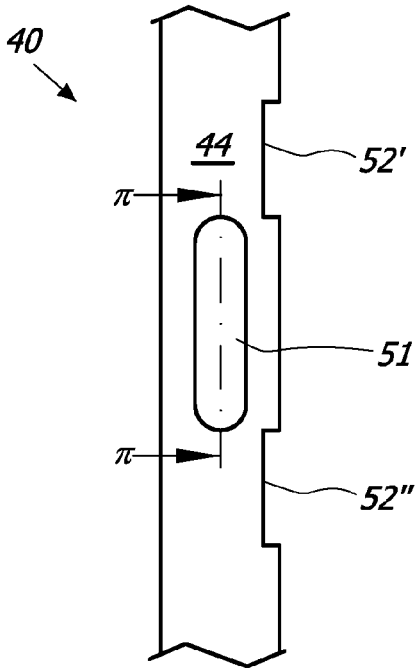


FIG. 7b

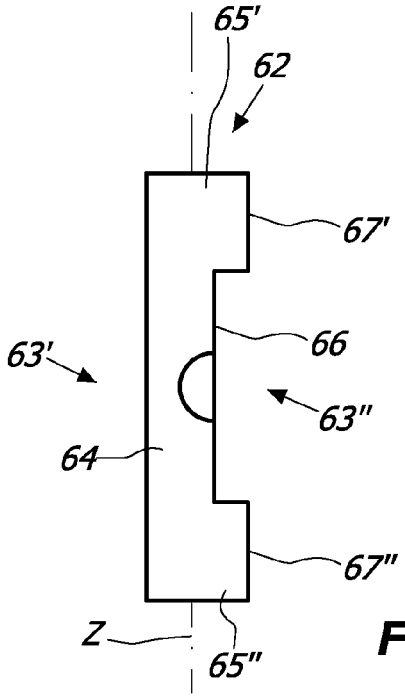


FIG. 7c

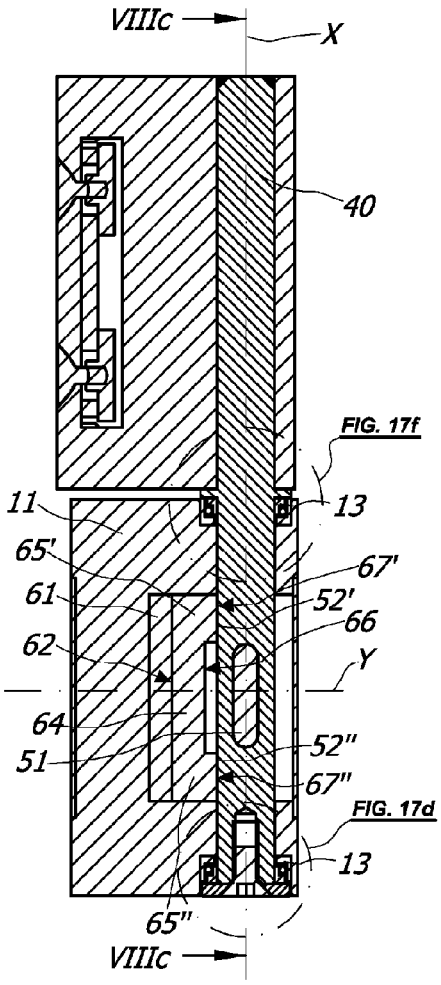
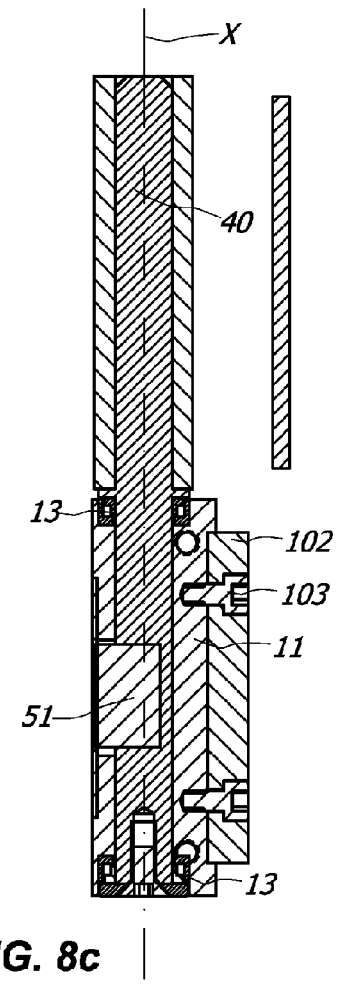


FIG. 8b



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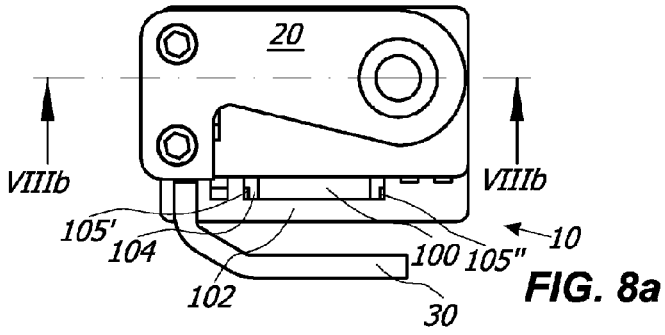

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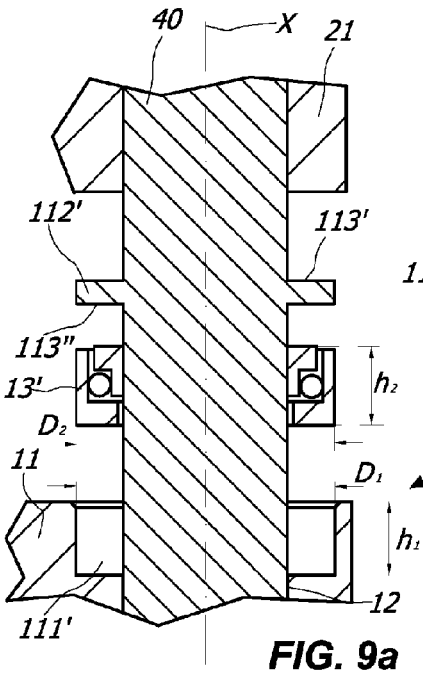

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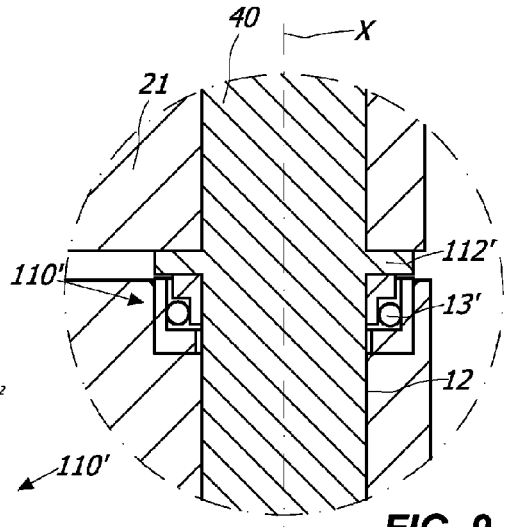

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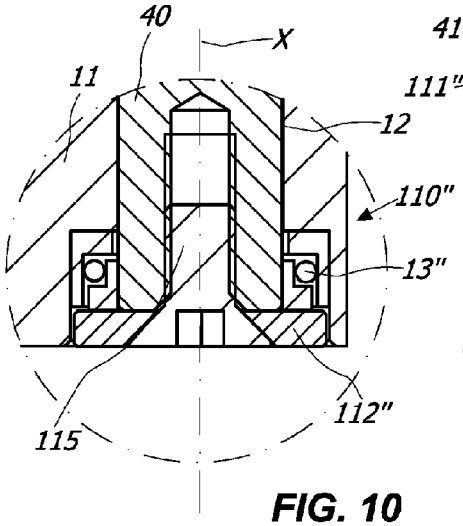

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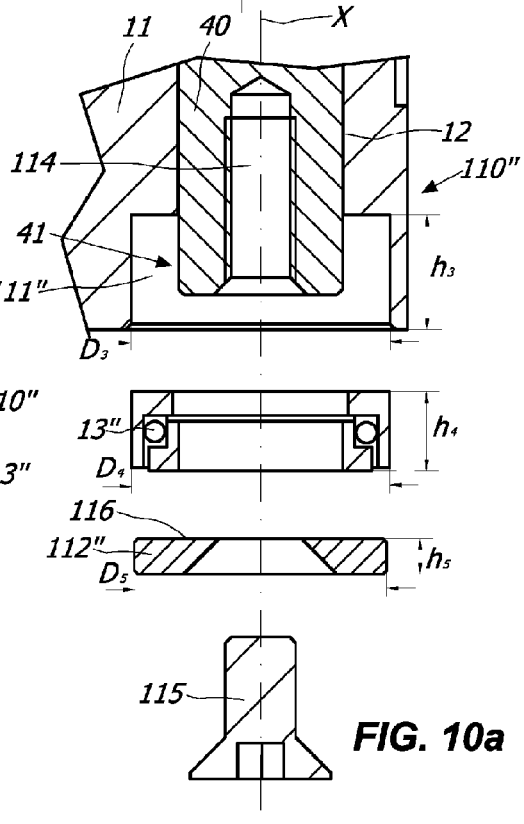

FIG. 10a

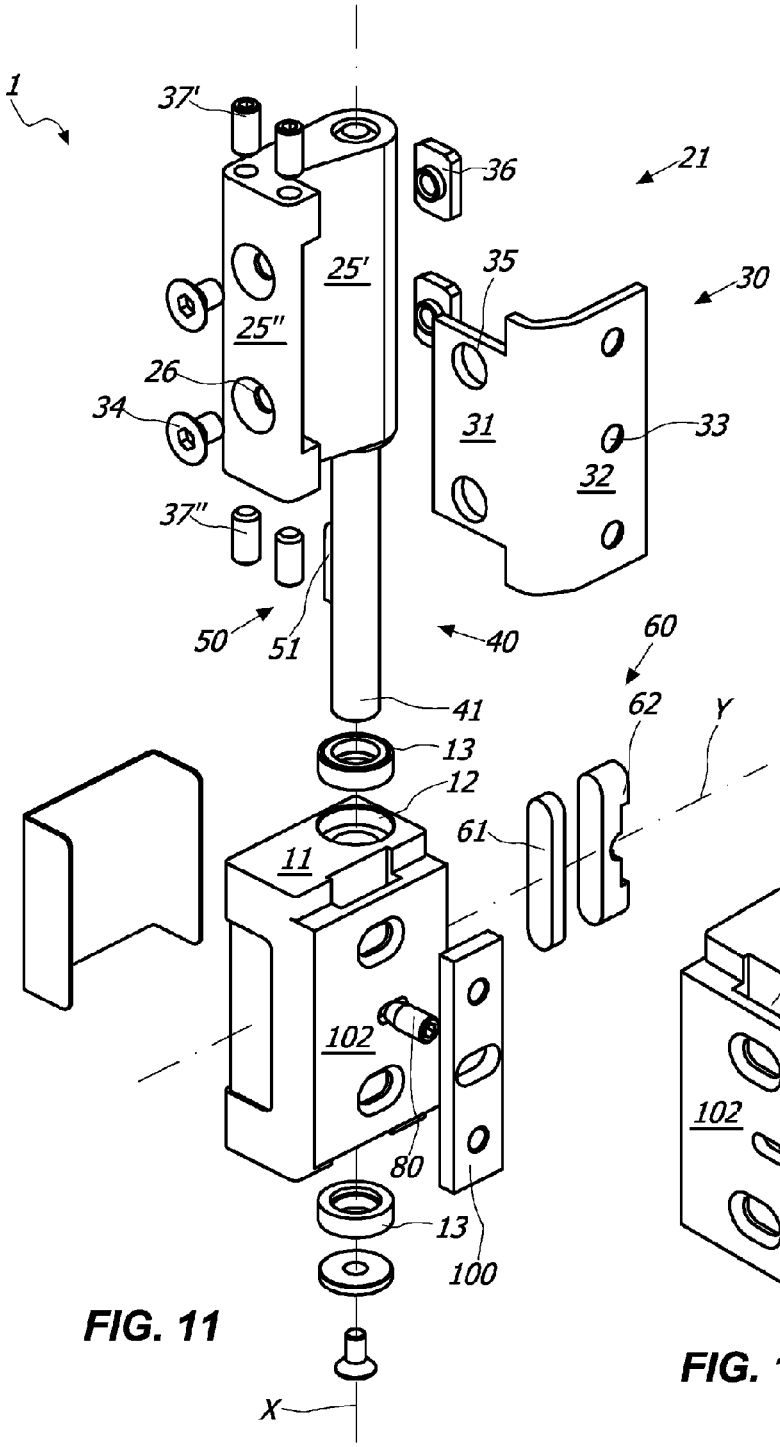
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FIG. 11

FIG. 12

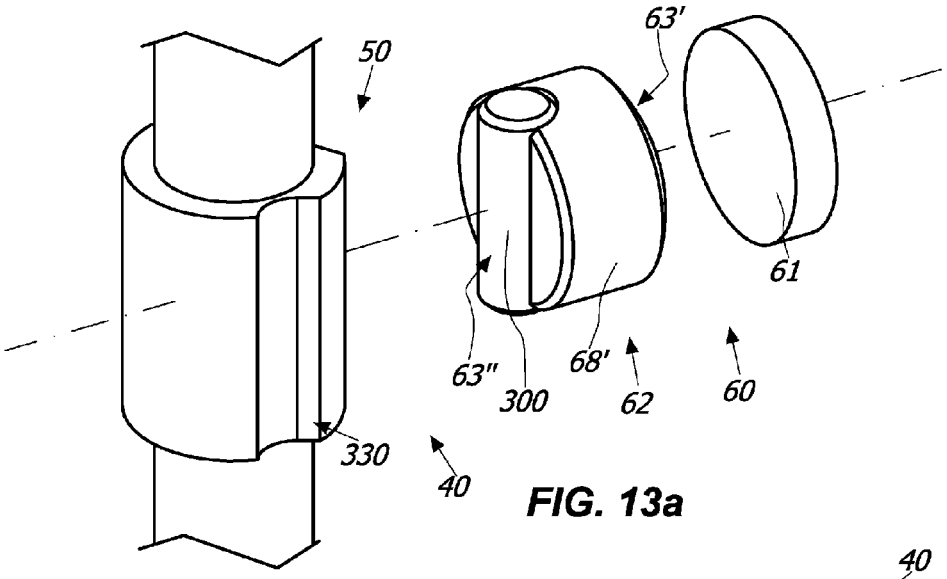
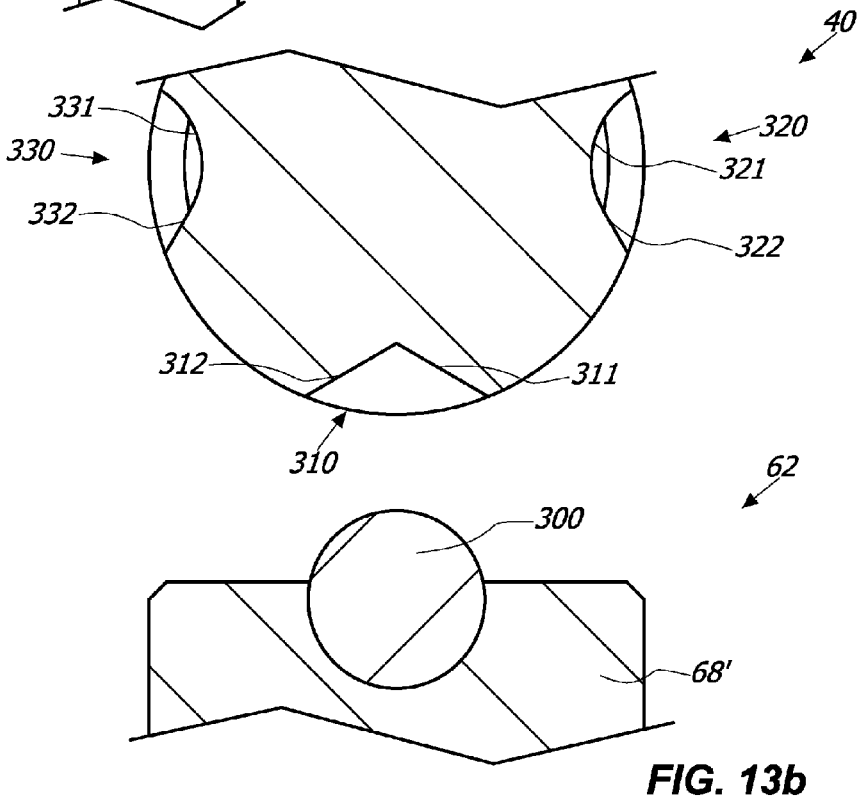


FIG. 13a



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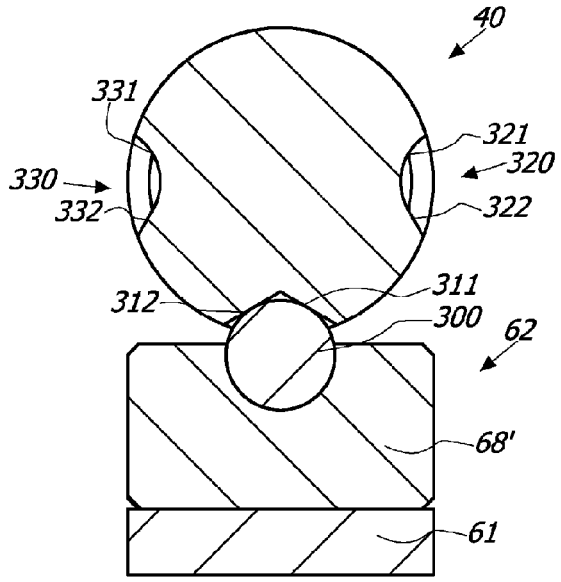
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FIG. 14

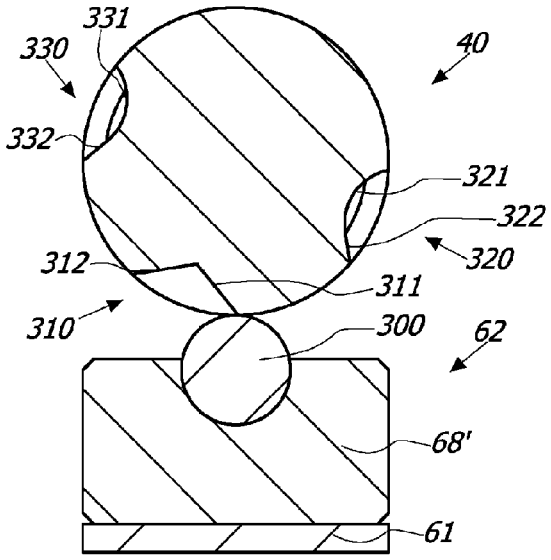
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FIG. 15

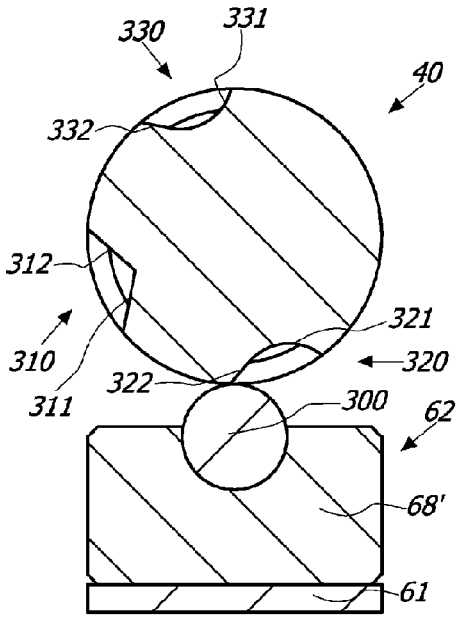
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FIG. 16

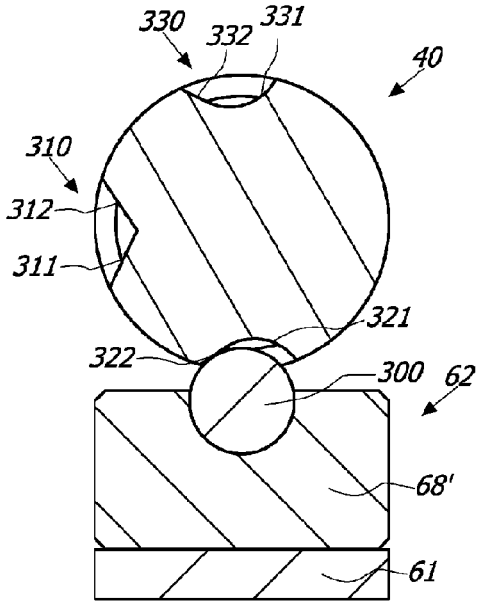
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FIG. 17

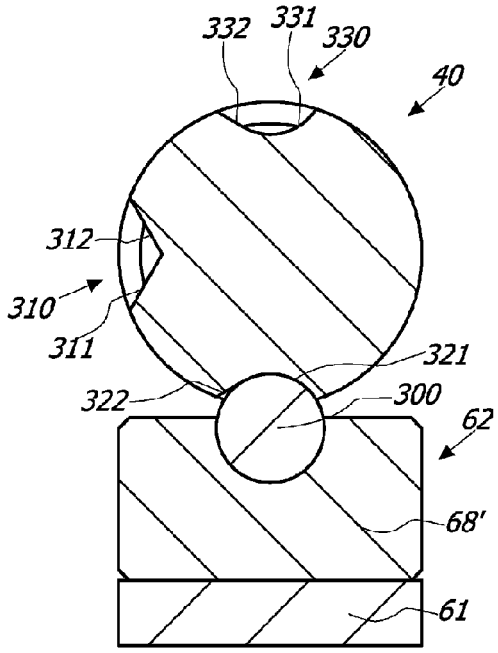
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FIG. 18

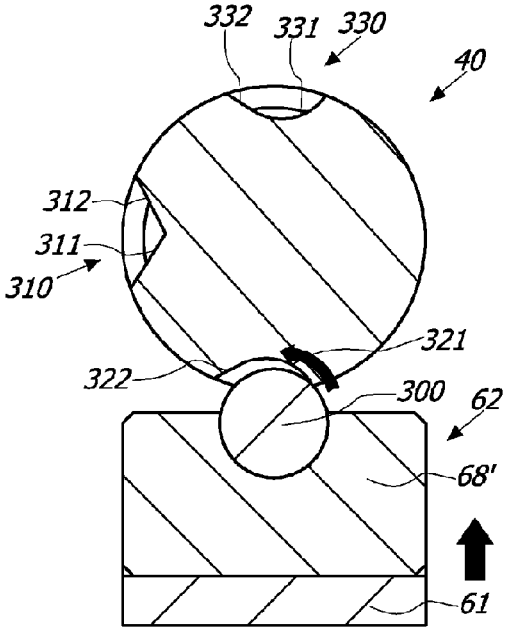
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FIG. 19

CONCEALABLE HINGE FOR THE CONTROLLED ROTATABLE MOVEMENT OF A DOOR, IN PARTICULAR A REINFORCED DOOR

FIELD OF INVENTION

The present invention is generally applicable to the technical field of the closing or damping/control hinges, and particularly relates to a hinge for the controlled rotatable movement of a door, in particular but not exclusively a reinforced door.

BACKGROUND OF THE INVENTION

As known, the closing or damping hinges generally comprise a movable element, usually fixed to a door, a shutter or the like, which movable element is pivoted on a fixed element, usually fixed to a support frame, or to a wall and/or the floor.

More particularly, in the case of concealed hinges for reinforced doors or the like, the fixed element of the hinge is inserted into a support structure that includes a rear tubular counterframe anchored to a wall or like support and a front frame anchored to the counterframe.

On the other hand, the movable element generally includes a connecting plate to be fixed to the door intended to come out from the tubular support structure in the open position and to retract completely within the tubular support structure in the closed position.

Generally, such hinges are purely mechanical, and not allow any kind of adjustment of the opening angle of the door or anyway no control of the movement of the door.

Examples of such known hinges are shown in the documents U.S. Pat. No. 5,075,928 and WO2010049860.

The absence of control makes such hinges extremely dangerous, since due to the great weight of the reinforced door there is the danger of unhinging of the door or the inflection of the tubular support structure to which the hinge is anchored.

Similarly, due to the great weight of the door, the hinge tends to lose the initial position and/or to misalign.

Moreover, the adjustment of the position of the door is difficult and complicated. Furtherly, to do this operation at least two operators are needed.

Another recognized drawback of these hinges is in the high frictions between fixed and movable element, which leads to frequent wear and breakage, with consequent need for continuing maintenance.

SUMMARY OF THE INVENTION

An object of the present invention is to overcome at least partly the above mentioned drawbacks, by providing a hinge having high performances, simple construction and low cost.

Another object of the invention is to provide a hinge which allows controlling the movement of the door upon its opening and/or its closing.

Another object of the invention is to provide a strong and reliable hinge.

Another object of the invention is to provide a hinge having extremely small dimensions.

Another object of the invention is to provide a hinge suitable for supporting very heavy doors and shutters.

Another object of the invention is to provide a hinge that has a minimum number of constituent parts.

Another object of the invention is to provide a hinge suitable to maintain the exact closing position during time.

Another object of the invention is to provide a hinge that is safe.

Another object of the invention is to provide a hinge that is easy to install.

Another object of the invention is to provide a hinge that simplifies the operations of maintenance and/or replacement thereof.

Another object of the invention is to provide a hinge which allows a simple adjustment of the door to which it is connected.

These objects, as well as other which will appear clearer hereafter, are fulfilled by a hinge having one or more of the features herein disclosed, claimed and/or shown.

Advantageous embodiments of the invention are defined in accordance with the dependent claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Further features and advantages of the invention will appear more evident upon reading the detailed description of some preferred, non-exclusive embodiments of a hinge **1**, which is described as non-limiting examples with the help of the annexed drawings, in which:

FIG. **1** is an exploded view of an embodiment of the hinge **1**;

FIGS. **2***a* and **2***b* are perspective views of the embodiment of the hinge **1** of FIG. **1** respectively in the closed and open position;

FIGS. **3***a* and **3***b* are respectively perspective and upper views of the embodiment of the hinge **1** of FIG. **1** in which the movable element **20** is mounted on a door D and the fixed element **10** is mounted on a frame F, the door D being in the closed position;

FIGS. **3***c* and **3***d* are respectively perspective and upper views of the embodiment of the hinge **1** of FIG. **1** in which the movable element **20** is mounted on a door D and the fixed element **10** is mounted on a frame F, the door D being in the open position;

FIG. **4** is a schematic view of the assembly pivot **40** cam **51** interface element **62** elastic counteracting element **61** to be used in the embodiment of the hinge **1** of FIG. **1**;

FIGS. **5** and **6** are respectively side views of a first embodiment of the interface element **62** and the pivot **40** to be used in the embodiment of the hinge **1** of FIG. **1**;

FIGS. **7***a* and **7***b* are side views of a second embodiment of the pivot **40** to be used in the embodiment of the hinge **1** of FIG. **1**;

FIG. **7***c* is a side view of a second embodiment of the interface element **62** to be used in the embodiment of the hinge **1** of FIG. **1**;

FIGS. **8***a*, **8***b* and **8***c* are respective top view and views sectioned along a plane VIIIb-VIIIb and along a plane VIIc-VIIc of the embodiment of the hinge **1** of FIG. **1**, the hinge being in the closed position;

FIG. **9** is an enlarged view of some details of FIG. **8***b*, with in FIG. **9***a* an exploded view of such details;

FIG. **10** is an enlarged view of further details of FIG. **8***b*, with in FIG. **10***a* an exploded view of such details;

FIG. **11** is an exploded perspective view of a further embodiment of the hinge **1**, in which the box-shaped hinge body **11** is integral with the backplate **102**;

FIG. **12** is a perspective view of the hinge body **11** of the embodiment of the hinge **1** of FIG. **11**;

FIGS. **13***a* and **13***b* are respectively perspective and sectional partly cut views of some details of a further embodiment of the cam means **50** and the follower means **60**;

FIGS. **14** to **19** are sectional views of the cam means **50** and follower means **60** of FIGS. **13***a* and **13***b* in various operational steps, in which for each step the relative position of the cam means **50**, the pushing member **68'** and the elastic counteracting element **61** is enlargedly shown.

DETAILED DESCRIPTION OF SOME PREFERRED EMBODIMENTS

With reference to the above figures, the hinge according to the invention, generally indicated **1**, is particularly useful for the rotatable possibly controlled movement during opening and/or closing of a closing element D, such as a reinforced door, which may be anchored to a stationary support structure, such as a wall, a floor or a ceiling.

Suitably, the hinge **1** may be concealedly inserted in a tubular support structure, which may be formed in a per se known manner by a rear counterframe CF, which can be anchored to the wall W or like support, and by a front frame F anchored to the counterframe CF.

In particular, the hinge **1** can be configured as a concealed "Anuba" hinge anchored to the frame F by the plate P_2.

Advantageously, the hinge **1** is concealedly insertable in the support structure formed by the tubular rear counterframe CF and the front frame F.

Conveniently, the hinge **1** may include a fixed element **10** to be fixed to the stationary support W, for example by the frame F or the counterframe CF, on which a movable element **20** is pivoted to rotate about a longitudinal axis X, which may be substantially vertical, between an open position and a closed position.

In particular, the hinge **1** may include, respectively may consist of, a lower fixed half-hinge **10** and a movable upper half-hinge **20** rotatably coupled each other to rotate between the open and closed positions about the axis X.

Advantageously, the lower fixed half-hinge **10** may include a box-shaped hinge body **11** anchored to the stationary support W, while the movable upper half-hinge **20** may include means **21** for fixing to the door D.

Suitably, the hinge body **11** may be concealedly insertable within the support structure formed by the tubular rear counterframe CF and the front frame F, while the connecting means **21** may be defined by a connecting plate susceptible to extend from the tubular support structure in the open position of the door D, as shown for example in FIGS. **3***c* and **3***d*, and to retract within the same tubular support structure in the closed position of the door D, as shown for example in FIGS. **3***a* and **3***b*.

In particular, the connecting plate **21** of the hinge **1** may be rotatably connected to the body **11** by means of the hinge pivot **40**, which will be better described later.

Advantageously, the box-shaped hinge body **11** may include a passing-through seat **12** defining the axis X within which is inserted with minimal clearance the pivot **40**, which may be unitary connected to the connecting plate **21**.

In this way, the pivot **40** is unitary movable with the door D between the open and closed positions. Thanks to this feature, the hinge **1** is able to support even very heavy doors D without misalignments or changing of the behaviour.

Suitably, at the ends of the passing-through seat **12** of the box-shaped body **11** respective anti-friction elements **13** may be placed, such as bearings. This allows the movable element **20** to rotate about the axis X with minimum friction, so that the hinge **1** is able to support even very heavy doors D.

The hinge body **11** may internally include a working chamber **14** defining a second axis Y which is substantially perpendicular to the first axis X defined by the passing-through seat **12** for the pivot **40**.

Suitably, the pivot **40** may include cam means **50** rotating around the axis X, while the working chamber **14** may include follower means **60** interacting with the former to slidably move along the axis Y between a first and a second end-stroke position, corresponding for example to the open and closed door D position.

The follower means **60** may include an elastic counteracting element susceptible to elastically oppose the pushing force imparted by the cam means. As non-limiting example, the elastic counteracting element may include, respectively may consist of, a spring, a nitrogen cylinder or a portion of polymeric material.

In a preferred but not exclusive embodiment of the hinge **1**, the elastic counteracting element may consist of an elastomer body **61**, which may be plate-shaped, disk-shaped or cylindrical-shaped.

Advantageously, the elastomer body **61** may be made of a polyurethane elastomer of the compact type, for example Vulkollan®. Suitably, the elastomer may have a Shore A hardness of 50 ShA to 95 ShA, preferably of 70 ShA to 90 ShA. More preferably, the elastomer body **61** may have a Shore A hardness of 80 ShA.

The use of the elastomer in place of the classic spring allows for a very high braking force, in a very small space. In fact, the stroke of the elastomer body **61** along the axis Y may be of some millimeters, for example 2-4 mm.

Moreover, the elastomer body **61** allows achievement of a braking effect of great efficiency in a purely mechanical hinge without the use of oil or like hydraulic damping means, for example during the opening.

In fact, upon the opening of the door D the elastic counteracting element **61** passes from the first to the second end-stroke position and remains in this position until the closing of the door by a user, so that the hinge **1** is a control hinge braked during opening.

Moreover, the follower means **60** may advantageously include an interface element **62** having a first end **63'** which interacts with the elastic counteracting element **61** and a second end **63"** interacts with the cam means **50**.

Advantageously, the interface element **62** may have a substantially "C"-shape with a central elongated portion **64** defining a third longitudinal axis Z substantially parallel to the axis X and perpendicular to the axis Y and a pair of end transverse appendices **65'**, **65"** substantially perpendicular to the axis X and parallel to the axis Y.

Both the elongated central portion **64** and the end transverse appendices **65'**, **65"** may include respective operating surfaces **66**, **67'**, **67"** placed at the front end **63"**, the function of which is better explained later.

Moreover, the pivot **40** may suitably include the cam means **50**, so that the latter rotate unitary with the former around the axis X. Advantageously, the cam means **50** may include one or more cam elements susceptible to interact with the follower means **60**.

More particularly, in the pivot **40** of FIGS. **4** and **6** the cam means **50** may include a single cam element, while in the pivot **40** of FIGS. **7***a* and **7***b* the cam means **50** may include two cam elements.

For example, the single cam element may be defined by a plate-shaped body **51** insertable transversely in a removable manner within a seat **42** of the pivot **40** so that a portion of the former extends from the latter. This configuration simplifies the assembly of the hinge **1**.

On the other hand, the plate-shaped body **51** may be integrated into the pivot **40** in an unremovable manner.

Suitably, the plate-shaped body **51** may have a front peripheral edge **53** susceptible to interact with the interface element **62**, for example in correspondence of the operating surface **66**. To this end, the front peripheral edge **53** may be appropriately rounded.

In this way, the interface element **62** progressively compresses the elastomer body **61** upon the opening of the door D. The elastomer body **61** may further be susceptible to remain in the configuration elastically deformed until the closing of the door D by a user. In other words, the hinge **1** is elastically braking upon opening.

Suitably the hinge **1** may be configured so that the cam element **51** interacts with the operating surface **66** after an angular rotation of the door D, for example 45°. Following interaction with the interface element **62**, the cam element **51** compresses the elastomer body **61**, so that the hinge is mechanically braked upon opening during the subsequent angular rotation, for example the next 45°. In other words, the first angular rotation is free, that is not braked, while the subsequent angular rotation is braked by the braking action of the elastomer body **61**.

In one preferred but not exclusive embodiment, two cam elements may be provided, in particular a pair of first cam elements **52'**, **52"** susceptible to interact with the operating surfaces **67'**, **67"** of the interface element **62** and a second cam element consisting of the plate-shaped element **51** which is susceptible to interact with the operating surface **66**.

The first cam elements **52'**, **52"** may be defined by a pair of substantially flat faces formed on the outer surface **44** of the pivot **40**, in longitudinally staggered positions so as to be operatively in contact with the operating planar surfaces **67'**, **67"** of the interface element **62**.

Conveniently, the cam means **50** and the follower means **60** may be configured so that the substantially flat faces **52'**, **52"** and the operative surfaces **67'**, **67"** are substantially parallel and in mutual contact when the door D is in the closed position, as shown for example in FIGS. **11***a* to **11***d*, and are substantially perpendicular and spaced apart each other when the door D is in the open position, as shown for example in FIGS. **13***a* to **13***d*.

The plate-shaped element **51** may further define a plane π substantially perpendicular to the substantially planar faces **52'**, **52"**.

In this way, it is possible to achieve a full control on the door D upon the opening, throughout all the angular rotation thereof.

In fact, for a first portion of angular rotation the substantially flat faces **52'**, **52"** and the operative surfaces **67'**, **67"** interact with each other to partially compress the elastomeric body **61**, thus urging it from the rest or starting stroke position to an intermediate compressed position. Further, for the next portion of the angular rotation of the door D the plate-shaped element **51** and the operating surface **66** of the interface element **62** interact each other so as to further compress the elastomeric body **61**, thus compressing it from the intermediate compressed position to the totally compressed or end stroke position.

This allows to progressively compress the elastic element, so as to obtain a braking effect for the entire angular rotation of the door D.

In another preferred but not exclusive embodiment, shown for example in the FIGS. **13***a* to **19**, the interface element **62** may be configured as a pushing member **68'** and include a protrusion **300**, having a generally hemispherical shape. On the other hand, the cam means **50** may include a plurality of seats **310**, **320**, **330** each corresponding to a supper position of the door.

More in particular, the seats **310**, **320**, **330** are able to receive the protrusion **300** to supper the door in the supper positions.

Suitably, the seat **310** may correspond to the closed door position, while the seats **320**, **330** may correspond to the open door positions. Advantageously, the latter may be mutually opposite with respect to the closed door position.

In a preferred but not exclusive embodiment, the seat **310** corresponding to the closed door position may have a generally "V"-shape with two consecutive planes **311**, **312** angled each other with predetermined angle.

In this way, as particularly shown in FIG. **15**, the sliding of the hemispherical protrusion **300** on the planes **311**, **312** upon the rotation of the door is simplified, so as to ensure the automatic closing of the door starting from a predetermined angle, for example 20°.

At the same time, the user can rotate the door from the closed door position in both opening directions.

To maximize this effect, the angle between the planes **311**, **312** may be at least 90°, preferably at least 110°. In a preferred but not exclusive embodiment, the angle between the planes **311**, **312** may be 120°.

Moreover, each of the seats **320**, **330** corresponding to the open door positions may advantageously have two consecutive portions **321**, **322**; **331**, **332** having different shape.

The first portions **322**; **332** may be generally flat, while the second portions **321**; **331** may be countershaped with respect to the shape of the protrusion **300**, and in particular may be hemispherical.

In this way, the first flat portions **322**; **332** may promote the sliding of the projection **310** thereon to convey it towards the second portions **321**; **331**, suitable to supper the door.

In this way, as particularly shown in FIG. **16**, the automatic opening of the door starting from a predetermined angle, for example 70°, is ensured.

As particularly shown in FIG. **17**, the first flat portions **322**; **332** act as pilot members for the second hemispherical portions **321**; **331**, so that the insertion of the protrusion **300** in the latter takes place without noise.

Advantageously, the first flat portions **322**; **332** may be substantially perpendicular to the planes **312**, **311**.

Moreover, thanks to the above configuration the door may be rotated from the supper position only in one direction. In other words, the rotation in the other direction is prevented.

Indeed, as particularly shown in FIG. **19**, if a user attempts to further rotate the door, the momentum caused by the elastic counteracting element **61** opposes this force, which momentum urges the one against the other the protrusion **300** and the second portions **321**; **331**.

Suitably, the elastic counteracting element **61** may be configured so as to allow a further slight rotation of the door after the supper position in the door open position. To this end, the elastic counteracting element **61** after this minimum rotation can reach the position of maximum compression.

This absorbs the shock undergone by the door upon the reaching of the supper position. This configuration is particularly advantageous in the case of glass door, which in the case of abrupt shock could be damaged or broken.

The embodiment of the cam means **50** and the follower means **60** shown in FIGS. **13***a* to **19** and described above is particularly advantageous with the above described elastic counteracting element **61** made of elastomer.

In fact, in the latter a minimum stroke corresponds to a very high strength.

Therefore, suitably precompressing the elastic counteracting element **61** in the working chamber **14** the strength of the hinge **1** is maximized.

Also, the elastic counteracting element **61** made of elastomer maximizes the effect of stopping the rotation, as described above.

In one preferred but not exclusive embodiment, it is possible to adjust the opening angle of the door D.

For the purpose, an adjusting screw **80** may be provided transversely inserted in the hinge body **11** with a first operating end **81** accessible by a user to adjust the penetration of the former **80** through the corresponding wall of the latter **11** and an opposite end **82** susceptible to come into contact with the plate-shaped element **51**.

By appropriately acting on the operating end **81** of the screw **80** the opening angle of the door can be adjusted in a simple and rapid manner, so as to avoid any impact of the door D against the stationary support W.

The hinge **1** is extremely effective and performing, and is also greatly simple to assemble.

For example, the hinge body **11** may have, in addition to the passing-through seat **12** for containing the pivot **40**, a passing-through opening **16** to make accessible the working chamber **14** from the outside.

In particular, the passing-through opening **16** may be susceptible to allow the insertion within the working chamber **14** of both the follower means **60** and the cam means **50**, in particular of the plate-shaped element **51**.

The passing-through opening **16** defines an axis Y' perpendicular to both the axis Y and the axis X.

In practice, both the cam means **50** and the follower means **60** may be removably inserted in the working chamber **14** by sliding along the axis Y'.

This is particularly advantageous if it is necessary to change the elastic element **61**, for example to insert a softer or harder one in order to vary the braking action of the hinge **1**, or to change the plate-shaped element **51**, for example to insert one of different configuration to vary the braking action of the hinge **1**.

In fact, in order to mount the cam means **50** and the follower means **60**, it is simply needed to insert within the working chamber **14** through the passing-through opening **16** the elastic counteracting element **61** and the interface element **62**, subsequently to insert the pivot **40** into the seat **12** and then rotate the latter to move the seat **42** thereof in correspondence of the same passing-through opening **16**, so as to allow the insertion of the plate-shaped element **51**. The dismounting thereof may occur in the reverse order.

The hinge **1**, in addition to the above mentioned features and advantages, is particularly advantageous because it is possible to adjust the position of the door D in the three dimensions, that is both in height and in a plane substantially parallel to the floor as shown for example in FIG. **3***c*.

In fact, the connecting plate **21** may include a first portion **25'** susceptible to receive the pivot **40** and a second portion **25"** susceptible to receive the mounting bracket **30** and to allow the adjustment along the directions d, d', as shown in FIG. **2***b*.

Suitably, the mounting bracket **30** may have a first plate portion **31** operatively fixable to the first portion **25'** of the mounting body **24** monolithically coupled with a second plate portion **32**, connectable in turn to the door D by means of suitable screws insertable into the holes **33**.

The operational connection between the first portion **25'** of the mounting body **24** and the first plate portion **31** of the mounting bracket **30** may be made by means of suitable screws **34** inserted through the holes **26** of the mounting body **24** and the openings **35** of the mounting bracket **30** and lockable in suitable locking elements **36**.

By suitably operating on the screws **34** it is possible to move the mounting bracket **30**, and then the door D, along the direction d'. In fact, by appropriately unscrewing the screws **34** it is possible to move the mounting bracket **30** for a stroke equal to the length L of the openings **35** in which the screws **34** are inserted.

The movement along the vertical direction d is ensured by the screws **37'**, **37"** inserted through the second portion **25"** of the connecting plate **21**, the first plate portion **31** of the mounting bracket **30** lying therebetween. As mentioned above, the latter is secured to the former by using the screws **34**.

The screws **37'**, **37"** can be operated by unscrewing the screws **34**, that allow the movement of the mounting bracket **30** with a stroke equal to the height H of the openings **35** in which the screws **34** are inserted.

To enable movement of the hinge **1** along the direction d", the hinge body **11** may be movably mounted on an anchor plate **100**, which may be anchored to the tubular support structure F, CF by using the screws **101**.

To this end, a backplate **102** may be provided, which may be coupled to the hinge body **11** by means of screws **103** to define an interspace **104** therebetween, in which interspace the anchor plate **100** is housed. The interspace **104** may include two side abutment surfaces **105'**, **105"**.

In the alternative embodiment shown in FIGS. **11** and **12**, the backplate **102** may be integrated into the hinge body **11**, i.e. the two parts can be made in a single piece. This allows to provide a more economic hinge **1**.

The screws **101** are engageable in the anchor plate **100** by passing through the slots **106** of the backplate **102**.

By appropriately acting on the screws **101** it is possible to move the assembly of the hinge body **11** and the backplate **102**, and then the door D, along the direction d". In fact, by suitably unscrewing the screws **101**, it is possible to move the assembly between the hinge body **11** and the backplate **102**, and hence the hinge **1**, for a stroke equal to the length L' of the slots **106** in which the screws **101** are inserted and/or the distance between the side abutment surfaces **105'**, **105"** of the interspace **104**.

The hinge **1** may further be designed to minimize friction between the fixed half-hinge **10** and the movable half-hinge **20**.

For this purpose, the upper end **110'** of the seat **12** may include a respective upper annular housing **111'** suitable to receive a respective upper antifriction element **13'**, such as a bearing.

As particularly shown in FIGS. **17***d* and **17***e*, the pivot **40** may include a upper radial expansion **112'**, for example a flange, with an upper operating surface **113'** susceptible to come in contact with the connecting plate **21** and a lower operating surface **113"** susceptible to remain faced to the upper annular housing **111'**.

Advantageously, the upper annular housing **111'** and the upper antifriction element **13'** may be mutually configured so that the lower operating surface **113"** of the upper radial expansion **112'** is susceptible to abut against the upper antifriction element **13'**. In this way, the pivot **40** can rotate onto the upper antifriction element **13'** by remaining mutually spaced from the hinge body **11**.

To this end, the inner diameter D_1 of the upper annular housing **111'** may be substantially equal to the outer diameter D_2 of the upper antifriction element **13'**, while the height h_2 of the latter may be slightly greater than the height h_1 of the former, for example a few tenths of a millimeter.

Furtherly, the lower end **110"** of the seat **12** suitably includes a lower annular housing **111"** susceptible to receive a respective lower antifriction element **13"**.

The lower end **41** of the pivot **40** may include a blind axial hole **114** susceptible to receive a locking screw **115**. A pressure element **112"** may further be provided, for example a washer, susceptible to be interposed between the locking screw **115** and the lower antifriction element **13"** to define a lower radial expansion. Advantageously, the latter may include an upper operative surface **116** susceptible to remain faced to the lower annular housing **111"**.

The latter, the lower antifriction element **13"** and the pivot **40** may be mutually configured so that the upper operative surface **116** of the pressure element **112"** is susceptible to abut against the pivot **40** and to remain spaced apart from the lower antifriction element **13"**.

In this way, the possible reaction force due to the rotation of the pivot **40** at its lower end **41** is loaded on the lower antifriction element **13"**.

This prevents the slipping of the pivot **40** from the seat **12** and/or the misalignment of the same pivot **40**.

To minimize friction between the lower fixed half-hinge **10** and the upper half-hinge **20**, the inner diameter D_3 of the lower annular housing **111"** may be substantially equal to the outer diameter D_4 of the lower antifriction element **13"**, while the outer diameter D_5 of the pressure element **112"** may be slightly less than the inner diameter D_3 of the lower annular housing **111"**.

Moreover, the height h_3 of the latter may suitably be substantially equal to the sum of the height h_4 of the lower antifriction element **13"** and the height h_5 of the pressure element **112"**.

Advantageously, the upper and lower antifriction elements **13'**, **13"** may consist of bearings of the axial-radial type, in order to suitably load thereon both the axial and the radial stresses due to the weight of the door D and/or their reactions forces.

From the above description, it is apparent that the hinge **1** fulfils the intended objects.

The hinge **1** is susceptible to many changes and variants. All particulars may be replaced by other technically equivalent elements, and the materials may be different according to the needs, without exceeding the scope of the invention defined by the appended claims.

The invention claimed is:

1. A concealed hinge for coupling a door and a tubular support structure, the tubular support structure including a rear counterframe and a front frame mutually coupled to each other, the hinge comprising:

a lower fixed half-hinge;

an upper movable half-hinge, the lower fixed half-hinge and the upper movable half-hinge being rotatably coupled each other for rotating about a first longitudinal axis between an open position and a closed position;

wherein said lower fixed half-hinge includes a box-shaped hinge body to be concealedly anchored within the tubular support structure, said upper movable half-hinge including a pivot defining said first axis and a connecting plate to be anchored to the door, the connecting plate being reciprocally connected with said pivot to extend from the tubular support structure in said open position and to concealedly retract within the tubular support structure in said closed position;

wherein said box-shaped hinge body includes a pivot seat for housing said pivot, the pivot including a cam member protruding therefrom, said box-shaped hinge body further including at least one working chamber including a follower member interacting with said cam member for sliding along a second longitudinal axis between a first and a second end-stroke position, the second longitudinal axis being perpendicular to said first axis, said follower member including at least one elastic counteracting element;

wherein said pivot includes a cam seat, the cam member being removably insertable into said cam seat, said box-shaped hinge body including at least one passing-through opening to allow insertion or removal of said cam member in or from said cam seat when the pivot is mounted into the pivot seat.

2. The hinge according to claim **1**, wherein said cam member includes at least one elongated appendix transversely extending with respect to said first axis to rotate about said first axis, said follower member including at least one interface element having a first end interacting with said at least one elastic counteracting element and a second end interacting with said at least one elongated appendix.

3. The hinge according to claim **2**, wherein said elongate appendix defines a plane parallel to said first axis and perpendicular to said second axis.

4. The hinge according to claim **3**, wherein said elongate appendix is defined by a plate-shaped element.

5. The hinge according to claim **1**, wherein said passing-through opening allows the insertion or removal of both said cam member in or from said seat and the follower member in or from the working chamber.

6. The hinge according to claim **5**, wherein said seat of said pivot, said working chamber and said at least one passing-through opening are reciprocally configured in such a manner that the mounting of said cam member and said follower member occurs by at first inserting said follower member within said working chamber through said passing-through opening, subsequently by inserting the pivot into said pivot seat and then by rotating the latter to move the cam seat in correspondence of said passing-through opening, so as to allow a user to insert said cam member.

7. The hinge according to claim **1**, wherein said box-shaped hinge body further comprises at least one abutment screw having a first operating end lying within said seat for abutting against said cam member and a second operating end accessible from outside by a user to adjust the penetration of said at least one abutment screw within said seat, so as to adjust the opening and/or closing angle of the hinge.

8. The hinge according to claim **7**, wherein said at least one abutment screw is transversely inserted within the hinge body with respect to said first axis, said cam member including at least one side wall configured to impact against said first operating end of said at least one abutment screw.

9. The hinge according to claim **1**, wherein said at least one elastic counteracting element includes an elastomer body.

10. The hinge according to claim **9**, wherein said elastomer body is compact polyurethane.

11. The hinge according to claim **10**, wherein said elastomer body has a Shore A hardness of 50 ShA to 95 ShA.

12. The hinge according to claim **1**, wherein said seat is defined by a hole passing-through said hinge body, the upper end of said seat including a respective upper annular housing configured to house a respective upper antifriction element, the lower end of said seat including a respective lower annular housing configured to house a respective lower antifriction element, said movable half-hinge being rotatably pivoted on said hinge body to rotate onto said upper antifriction element or said lower antifriction element, said pivot including a lower radially enlarged member configured to abut against said

lower antifriction element to prevent the slipping of the pivot from said seat or to prevent the misalignment of said pivot during use.

13. The hinge according to claim **12**, wherein said pivot includes an upper radially enlarged member with an upper operating surface configured to abut against said connecting plate and a lower operating surface configured to remain faced to the upper annular housing, said upper annular housing and upper antifriction element being mutually configured so that the lower operating surface of said upper radially enlarged member is configured to abut against said upper antifriction element, in such a manner that said pivot rotates onto said upper antifriction element remaining mutually spaced apart from said hinge body.

14. The hinge according to claim **13**, wherein said upper annular housing has a predetermined first inner diameter and first height, said upper antifriction element having a generally annular shape with a predetermined second outer diameter and second height, said first inner diameter being equal to said second outer diameter, said predetermined second height being slightly higher than said predetermined first height to minimize friction between said fixed lower half-hinge and said upper half-hinge.

15. The hinge according to claim **14**, wherein said lower radially enlarged member comprises an upper operating surface configured to remain facing the lower annular housing, said lower annular housing, pivot and lower antifriction element being mutually configured so that the upper operating surface of said lower radially enlarged member is directly engaged with said pivot.

16. The hinge according to claim **15**, wherein the lower end of said pivot includes an axial blind hole adapted to receive a locking screw, a pressure member interposed between said locking screw and said lower antifriction element being provided to define said lower radially enlarged member, and further wherein said locking screw, said pressure member, said axial blind hole, said lower antifriction element and said lower annular housing are configured to pull the pivot and to urge said lower operating surface of said upper radially enlarged member against said upper antifriction element and said upper operating surface of said lower radially enlarged member against said lower antifriction element.

17. The hinge according to claim **16**, wherein said lower annular housing has a predetermined third inner diameter and third height, said lower antifriction element having a generally annular shape with a predetermined fourth outer diameter and fourth height, said pressure member having a generally annular shape with a predetermined fifth outer diameter and fifth height, said third inner diameter being equal to said fourth outer diameter, said fifth outer diameter being slightly less than said third inner diameter to minimize friction between said fixed lower half-hinge and said upper movable half-hinge.

18. A concealed hinge for coupling a door and a tubular support structure, the tubular support structure including a rear counterframe and a front frame mutually coupled to each other, the hinge comprising:

a lower fixed half-hinge;

an upper movable half-hinge, the lower fixed half-hinge and the upper movable half-hinge being rotatably coupled each other for rotating about a first longitudinal axis between an open position and a closed position;

wherein said lower fixed half-hinge includes a box-shaped hinge body to be concealedly anchored within the tubular support structure, said upper movable half-hinge including a pivot defining said first axis and a connecting plate to be anchored to the door, the connecting plate being reciprocally connected with said pivot to extend from the tubular support structure in said open position and to concealedly retract within the tubular support structure in said closed position;

wherein said box-shaped hinge body includes a pivot seat for housing said pivot, the pivot including a cam member protruding therefrom, said box-shaped hinge body further including at least one working chamber including a follower member interacting with said cam member for sliding along a second longitudinal axis between a first and a second end-stroke position, the second longitudinal axis being perpendicular to said first axis, said follower member including at least one elastic counteracting element;

wherein said pivot includes a cam seat, the cam member including a plate-shaped element removably insertable into said cam seat, said box-shaped hinge body including at least one passing-through opening to allow insertion or removal of said plate-shaped element in or from said cam seat when the pivot is mounted into the pivot seat.

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